Duke Power
A Duke Energy Company

**Duke Power Company**
*A Duke Energy Company*
Energy Center
P.O. Box 1006
Charlotte, NC 28201-1006

April 11, 2000

Mr. William Grimley
Emission Measurement Center (MD-19)
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

SUBJECT: Electric Utility Steam Generating Unit Mercury Test Program
Duke Power Cliffside Steam Station

Dear Mr. Grimley:

As requested in the U.S. Environmental Protection Agency letter dated March 11, 1999, enclosed are two copies of the emission test report for Speciated Mercury Emissions Testing at Duke Power's Cliffside Steam Station. If there are any questions regarding this report, please contact me at (704) 373-3231.

Sincerely,

Heidi M. Knach

Heidi M. Knach,
Engineer
Air Quality

Enclosure

# SPECIATED MERCURY EMISSIONS TESTING

Performed For
**ELECTRIC POWER RESEARCH INSTITUTE**

At The
**Duke Energy Corporation**
**Cliffside Steam Station**
**Unit 1**
**Precipitator Inlet and Stack**
**Cliffside, North Carolina**

**September 1 and 2, 1999**

Mostardi Platt

A Full-Service
Environmental Consulting
Company

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Facsimile 630-993-9017

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MOSTARDI PLATT PROJECT 93504
DATE SUBMITTED: MARCH 20, 2000

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## CERTIFICATION SHEET

Having supervised and worked on the test program described in this report, and having written this report, I hereby certify the data, information, and results in this report to be accurate and true according to the methods and procedures used.

Data collected under the supervision of others is included in this report and is presumed to have been gathered in accordance with recognized standards.

MOSTARDI-PLATT ASSOCIATES, INC.

James R. Platt
Vice President, Emissions Services

Reviewed by:

Frank H. Jarke
Manager, Analytical and Quality Assurance

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# SPECIATED MERCURY EMISSIONS TESTING
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**Cliffside, North Carolina**
**September 1 and 2, 1999**

## 1.0 INTRODUCTION

### 1.1 Summary of Test Program

The United States Environmental Protection Agency (USEPA), is using its authority under section 114 of the Clean Air Act, as amended, to require that selected coal-fired utility steam generating units provide certain information that will allow the USEPA to calculate the annual mercury emissions from each unit. This information will assist the USEPA Administrator in determining whether it is appropriate and necessary to regulate emissions of Hazardous Air Pollutants (HAPs) from electric utility steam generating units. The Emission Measurement Branch (EMB) of the Office of Air Quality Planning and Standards (OAQPS) oversees the emission measurement activities. MOSTARDI-PLATT ASSOCIATES, INC. (Mostardi Platt) conducted the mercury emission measurements.

The USEPA selected the Cliffside Steam Station of Duke Energy Corporation in Cliffside, North Carolina to be one of seventy-eight coal-fired utility steam generating units to conduct mercury emissions measurements. Testing was performed at Unit 1 on September 1 and 2, 1999, and was the only tested unit at this facility. Simultaneous measurements were conducted at the precipitator inlet and stack of Unit 1. Mercury emissions were speciated into elemental, oxidized and particle-bound mercury using the Ontario-Hydro test method. Fuel samples were also collected concurrently with Ontario-Hydro samples in order to determine fuel mercury content.

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### 1.2 Key Personnel

The key personnel who coordinated the test program and their telephone numbers are:

- Mostardi Platt Vice President, James Platt 630-993-9000
- EPRI Program Manager, Paul Chu 650-855-2812
- Duke Energy Coordinator, Heidi Knach 704-373-3231

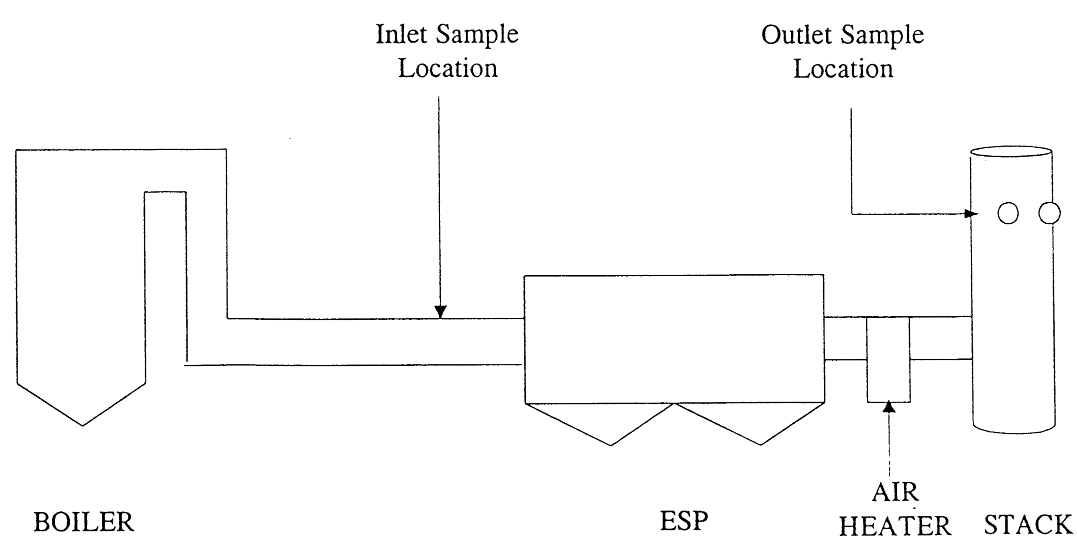
## 2.0 PLANT AND SAMPLING LOCATION DESCRIPTIONS

### 2.1 Process Description

Cliffside Unit 1 is a pulverized coal, tangentially fired boiler with a name plate rating of 40 MW gross. Figure 2-1 shows a schematic of the boiler and pollution control equipment, including sample points.

Unit 1 is a coal burning steam boiler. The steam is converted into mechanical energy by flowing through a turbine (generator) which produces electrical power. The unit was operating at or near full load during the tests. Fuel type, boiler operation and control device operation were all maintained at normal operating conditions.

**Figure 2-1 Schematic of the Boiler and Pollution Control Equipment.**




The following is a list of operating components for this unit:

- Combustion Engineering Balanced Draft Boiler
- 40 MW gross capacity

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- Fuel:
- Kentucky and West Virginia Bituminous Coal, Approximately 1% Sulfur

- $SO_2$ control: None

- $NO_X$ control: Modified Burners for Low $NO_X$

- Buell Engineering Hot-Side Electrostatic Precipitator

## 2.2 Control Equipment Description

Particulate emissions from the boiler are controlled by a Buell Engineering hot-side electrostatic precipitator with an estimated collection efficiency of 99.5%.

The flue gas at the inlet is approximately 600°F. At the outlet, the gas temperature is approximately 360°F and contains approximately 10 percent (10%) moisture.

## 2.3 Flue Gas Sampling Locations

### *2.3.1 Inlet Location*

Inlet samples were be collected at the precipitator inlet. A schematic and cross section of the inlet location are shown in Figure 2-2. This location does not meet the requirements of USEPA Method 1.

Sample ports exist in the bottom of the duct. Sampling was performed vertically up into the duct. There was only seventy eight (78) inches of clearance to the grating below the ports.

### *2.3.2 Outlet Location*

Outlet samples were be collected at the stack sample ports. A schematic and cross section of the stack location is shown in Figure 2-3. This location does meet the requirements of USEPA Method 1. Two (2), four-inch test ports exist at the stack.

The flue gas at the outlet was above the method specification of a minimum filtration temperature of 120°C. Therefore, in stack filtration per Method 17 was used.

## 2.4 Fuel Sampling Location

Fuel samples were collected at the base of the coal hopper to each individual pulverizing mill. One sample was collected from each feeder during each test run, and the feeder samples collected during a test run were composited prior to analysis.

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**Figure 2-2 Schematic of the Precipitator Inlet Sampling Location**

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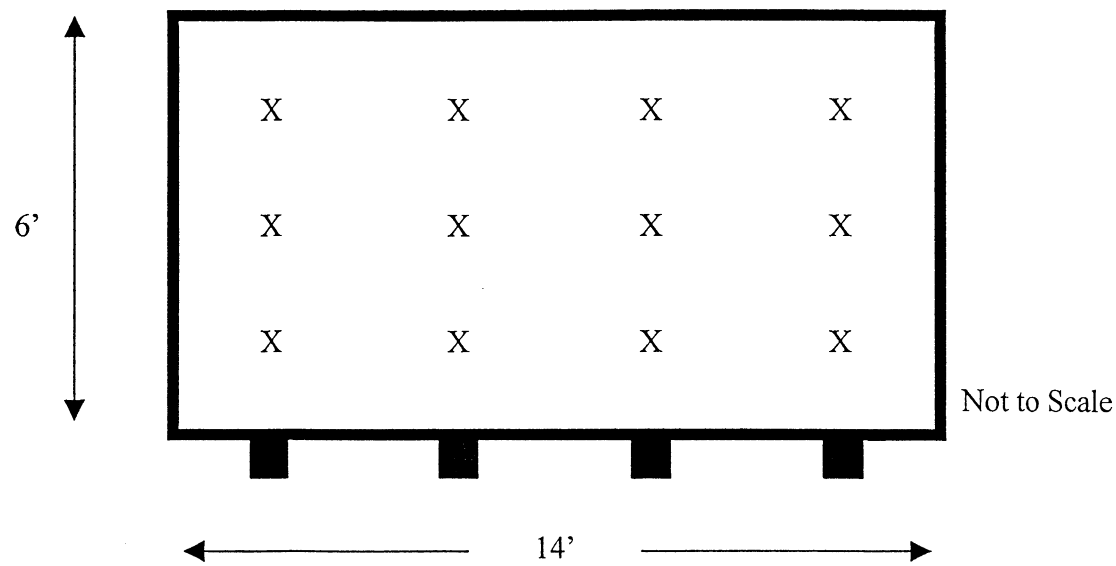
# EQUAL AREA TRAVERSE FOR RECTANGULAR DUCTS




| | | | |
|---|---|---|---|
| Job: | Duke Energy<br>Cliffside Steam Station | | |
| Date: | September 1 and 2, 1999 | Area: | 84.00 $ft^2$ |
| Unit No: | 1 | No. Test Ports: | 4 |
| Length: | 6 Feet | Tests Points per Port: | 3 |
| Width: | 14 Feet | Distance Between Ports: | 3.5 Feet |
| Duct No: | Inlet | Distance Between Points: | 1.5 Feet |

Mostardi Platt Project 93504

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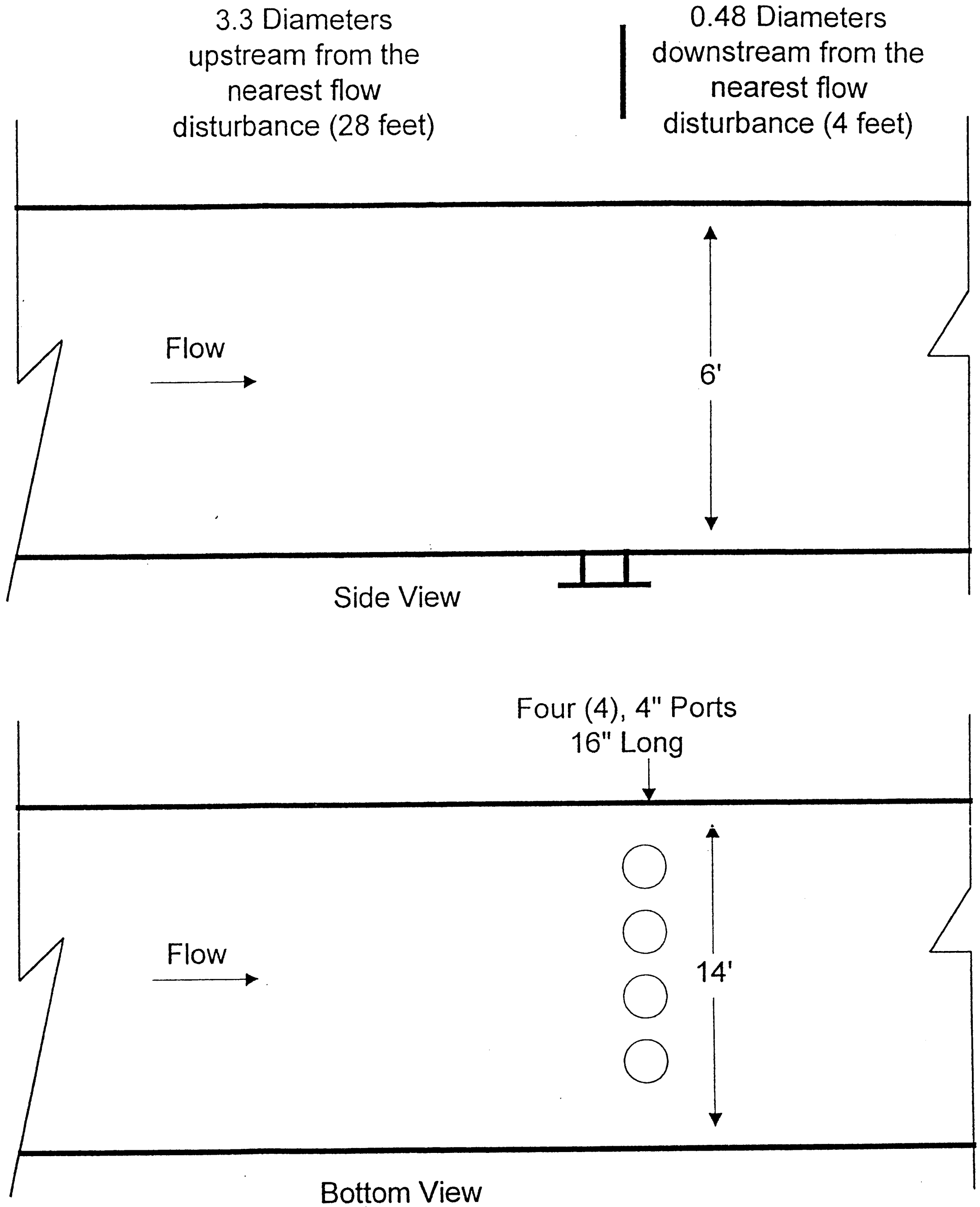


D = Equivalent Diameter

$$D = \frac{2 \times L \times W}{L + W}$$

$$D = \frac{2 \times 14 \times 6}{14 + 6}$$

$$D = 8.4$$

Not to Scale


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## Figure 2-3 Schematic of the Outlet Stack Sampling Location


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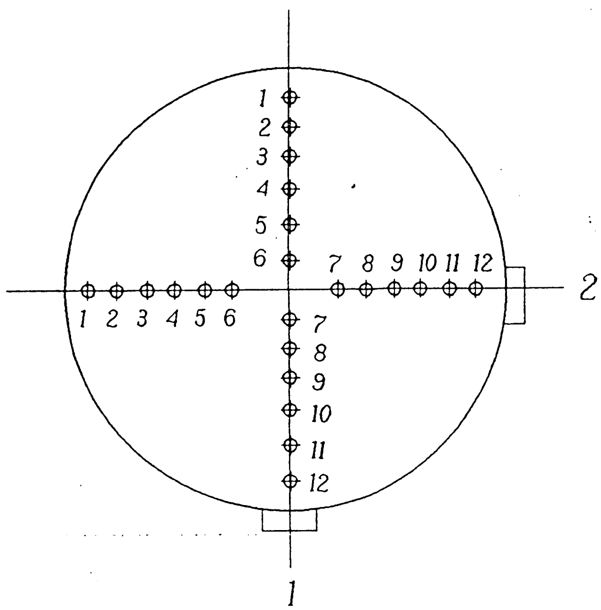
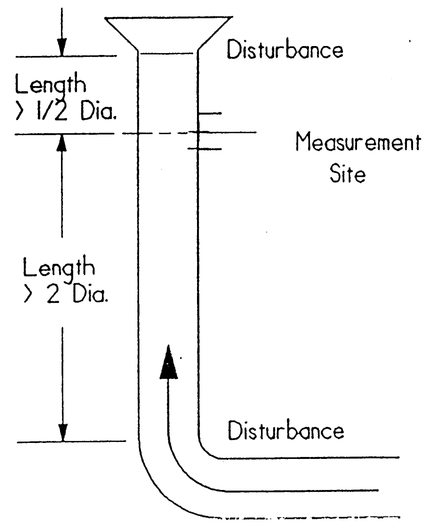
# EQUAL AREA TRAVERSE FOR ROUND DUCTS




Job: Duke Energy Corporation
Cliffside Steam Station

Date: September 1 and 2, 1999

Unit No: 1

Duct No: Stack

Duct Diameter: 10.5 Feet

Duct Area: 86.59 $ft^2$

No. Points Across Diameter: 12

No. of Ports: 2



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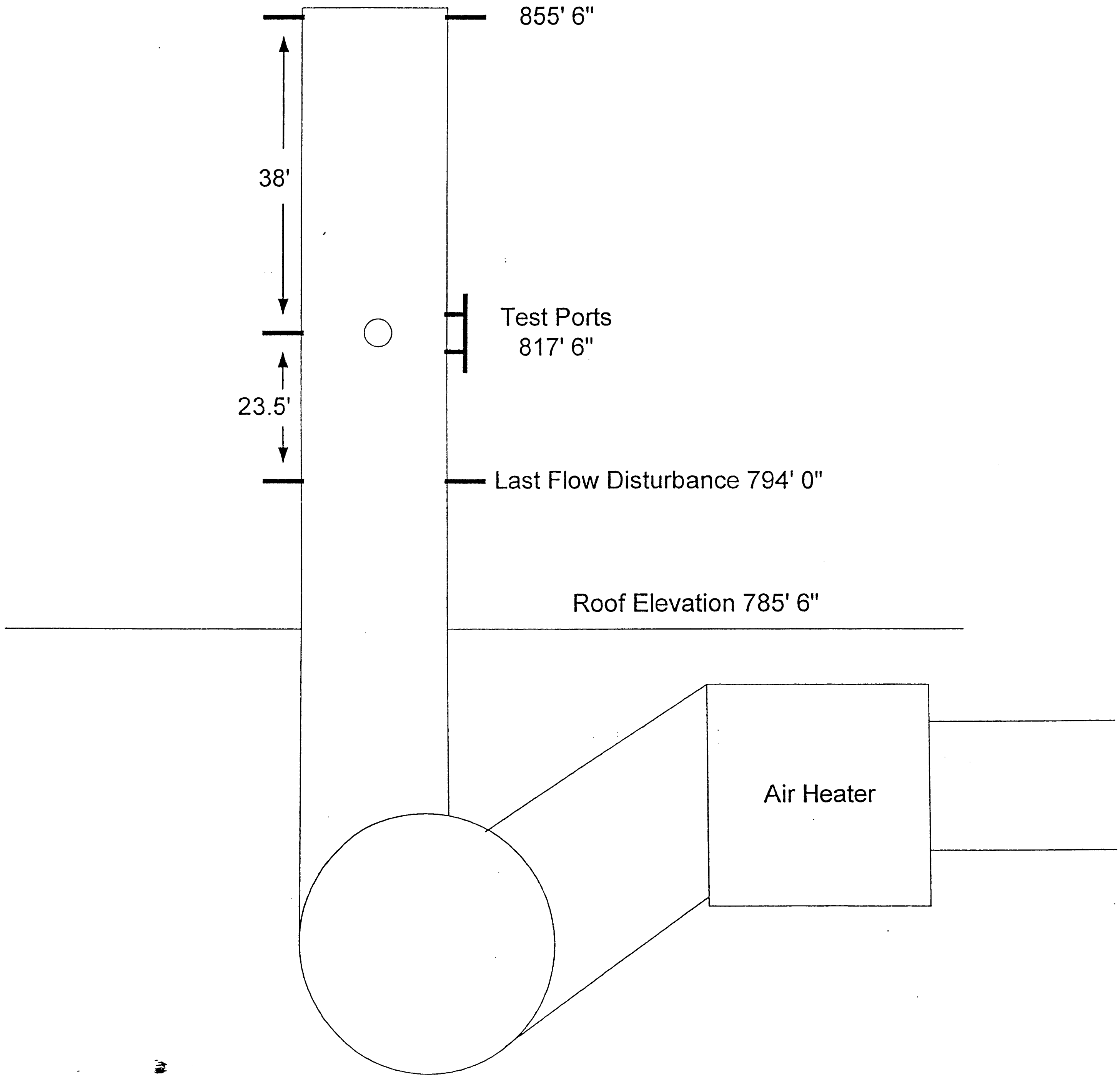



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## 3.0 SUMMARY AND DISCUSSION OF TEST RESULTS

### 3.1 Objectives and Test Matrix

The purpose of the test program was to quantify mercury emissions from this unit. This information will assist the USEPA Administrator in determining whether it is appropriate and necessary to regulate emissions of Hazardous Air Pollutants (HAPs) from electric utility steam generating units. The specific objectives, in order of priority were:

- Compare mass flow rates of mercury at the three sampling locations (fuel, precipitator inlet and stack).
- Measure speciated mercury emissions at the outlet.
- Measure speciated mercury concentrations at the inlet of the last air pollution control device.
- Measure mercury and chlorine content from the fuel being used during the testing.
- Measure the oxygen and carbon dioxide concentrations at the inlet and the outlet.
- Measure the volumetric gas flow at the inlet and the outlet.
- Measure the moisture content of the flue gas at the inlet and the outlet.
- Provide the above information to the USEPA for use in establishing mercury emission factors for this type of unit.

The test matrix is presented in Table 3-1. The table shows the testing performed at each location, methodologies employed and responsible organization.

Table 3-1
TEST MATRIX FOR THE CLIFFSIDE STEAM STATION

| Sampling Location | No. of Runs | Parameters | Sampling Method | Sample Run Time (min) | Analytical Method | Analytical Laboratory |
|---|---|---|---|---|---|---|
| Outlet | 3 | Speciated Hg | Ontario Hydro | 120 | EPA SW846 7470 | TEI |
| Outlet | 3 | Moisture | EPA 4 | 120 | Gravimetric | Mostardi Platt |
| Outlet | 3 | Flow | EPA 1 & 2 | 120 | Pitot Traverse | Mostardi Platt |
| Outlet | 3 | $O_2/CO_2$ | EPA 3 | 120 | Orsat | Mostardi Platt |
| Inlet | 3 | Speciated Hg | Ontario Hydro | 120 | EPA SW846 7470 | TEI |
| Inlet | 3 | Moisture | EPA 4 | 120 | Gravimetric | Mostardi Platt |
| Inlet | 3 | Flow | EPA 1 & 2 | 120 | Pitot Traverse | Mostardi Platt |
| Inlet | 3 | $O_2/CO_2$ | EPA 3 | 120 | Orsat | Mostardi Platt |
| Fuel | 3 | Hg, Cl in Fuel | Grab | 1 Sample Per Run | ASTM D3684 (Hg)<br>ASTM D4208 (Cl) | CTE |

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## 3.2 Field Test Changes and Problems

There were no field changes or problems encountered during this test program.

## 3.3 Presentation of Results

### *3.3.1 Mercury Mass Flow Rates*

The mass flow rates of mercury determined at each sample location are presented in Table 3-2.

**Table 3-2**
**SUMMARY OF RESULTS**

| Sample Location | Elemental Mercury (lb/hr) | Oxidized Mercury (lb/hr) | Particle-Bound Mercury (lb/hr) | Total Mercury (lb/hr) |
|---|---|---|---|---|
| Fuel | | | | |
| Run 1 | | | | 0.00245 |
| Run 2 | | | | 0.00174 |
| Run 3 | | | | 0.00210 |
| **Average** | | | | **0.00210** |
| Precipitator Inlet | | | | |
| Run 1 | 0.00149 | 0.00168 | 0.00008 | 0.00324 |
| Run 2 | 0.00151 | 0.00161 | 0.00004 | 0.00316 |
| Run 3 | 0.00317 | 0.00181 | 0.00003 | 0.00501 |
| **Average** | **0.00206** | **0.00170** | **0.00005** | **0.00380** |
| Stack | | | | |
| Run 1 | 0.00155 | 0.00110 | 0.00016 | 0.00281 |
| Run 2 | 0.00078 | 0.00090 | 0.00004 | 0.00172 |
| Run 3 | 0.00100 | 0.00156 | 0.00004 | 0.00259 |
| **Average** | **0.00111** | **0.00119** | **0.00008** | **0.00238** |

### *3.3.2 Comparison of Volumetric Flow Rate*

Volumetric flow rate is a critical factor in calculating mass flow rates. Ideally, the volumetric flow rate (corrected to standard pressure and temperature) measured at the inlet to the control device should be the same as that measured at the stack, which should be the same as that measured by the CEMS. Table 3-3 lists the comparison of flow rates of the three locations on a thousand standard cubic foot per minute basis (KSCFM).

| Table 3-3 COMPARISON OF VOLUMETRIC FLOW RATE DATA | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Inlet | | | Stack | | | CEMS |
| Run No. | KACFM | KSCFM | KDSCFM | KACFM | KSCFM | KDSCFM | KSCFM |
| Run 1 | 253.9 | 118.8 | 108.5 | 229.3 | 141.8 | 129.8 | 136.7 |
| Run 2 | 247.6 | 116.1 | 106.1 | 232.5 | 142.6 | 130.6 | 133.3 |
| Run 3 | 252.2 | 116.6 | 106.1 | 222.8 | 137.2 | 126.3 | 133.3 |
| Average | 251.2 | 117.2 | 106.9 | 228.2 | 140.5 | 128.9 | 134.4 |

The measured volumetric flowrate (KSCFM) at the inlet was approximately 17% lower than that measured at the outlet. The difference of the measured flowrate (KSCFM) at the outlet was within 5% of that determined by the continuous emissions monitoring system (CEMS). Because the inlet location did not meet the requirements of USEPA Method 1, the outlet volumetric flowrates were used to determine the emission rates at the inlet.

### *3.3.3 Individual Run Results*

A detailed summary of results for each sample run at the precipitator inlet and stack test locations are presented in Tables 3-4 and 3-5, respectively.

### *3.3.4 Process Operating Data*

The process operating data collected during the tests is included in Appendix A. A summary of the coal usage and mass emission rate of mercury available from coal are presented in Table 3-6.

## Table 3-4
## PRECIPITATOR INLET INDIVIDUAL RUN RESULTS

| Test Run Number: | 1 | 2 | 3 | Average |
|---|---|---|---|---|
| Source Condition | | Normal | | |
| Fuel Factor, dscf/$10^6$ Btu | 9648 | 9798 | 9647 | |
| Date | 9/2/99 | 9/1/99 | 9/1/99 | |
| Start Time | 10:35 | 14:50 | 8:15 | |
| End Time | 12:43 | 17:13 | 10:31 | |
| **Elemental Mercury:** | | | | |
| $HNO_3$-$H_2O_2$, ug detected | 0.338 | 0.246 | 0.305 | 0.296 |
| $H_2SO_4$-$KMnO_4$, ug detected | 3.703 | 3.703 | 8.303 | 5.236 |
| Reported, ug | 4.041 | 3.949 | 8.608 | 5.533 |
| ug/dscm | 3.07 | 3.09 | 6.70 | 4.29 |
| lb/hr | 0.00125 | 0.00123 | 0.00266 | 0.00171 |
| lb/hr (based on outlet dscfm) | 0.00149 | 0.00151 | 0.00317 | 0.00206 |
| lb/$10^{12}$ Btu | 2.32 | 2.37 | 5.11 | 3.27 |
| **Oxidized Mercury:** | | | | |
| KCl, ug detected | 4.538 | 4.198 | 4.918 | 4.551 |
| Reported, ug | 4.538 | 4.198 | 4.918 | 4.551 |
| ug/dscm | 3.45 | 3.28 | 3.83 | 3.52 |
| lb/hr | 0.00140 | 0.00131 | 0.00152 | 0.00141 |
| lb/hr (based on outlet dscfm) | 0.00168 | 0.00161 | 0.00181 | 0.00170 |
| lb/$10^{12}$ Btu | 2.61 | 2.52 | 2.92 | 2.68 |
| **Particle-bound Mercury:** | | | | |
| Filter, ug detected | 0.207 | 0.105 | 0.085 | 0.132 |
| $HNO_3$, ug detected | ND <0.004 | ND <0.004 | ND <0.004 | ND <0.004 |
| Reported, ug | 0.207 | 0.105 | 0.085 | 0.132 |
| ug/dscm | 0.16 | 0.08 | 0.07 | 0.10 |
| lb/hr | 0.00006 | 0.00003 | 0.00003 | 0.00004 |
| lb/hr (based on outlet dscfm) | 0.00008 | 0.00004 | 0.00003 | 0.00005 |
| lb/$10^{12}$ Btu | 0.12 | 0.06 | 0.05 | 0.08 |
| **Total Inlet Speciated Mercury:** | | | | |
| ug/dscm | 6.67 | 6.45 | 10.60 | 7.91 |
| lb/hr | 0.00271 | 0.00257 | 0.00421 | 0.00316 |
| lb/hr (based on outlet dscfm) | 0.00324 | 0.00316 | 0.00501 | 0.00380 |
| lb/$10^{12}$ Btu | 5.05 | 4.96 | 8.09 | 6.03 |
| Average Gas Volumetric Flow Rate: | | | | |
| @ Flue Conditions, acfm | 253,909 | 247,577 | 252,186 | 251,224 |
| @ Standard Conditions, dscfm | 108,498 | 106,134 | 106,065 | 106,899 |
| Average Gas Temperature, °F | 651.0 | 648.7 | 645.5 | 648.4 |
| Average Gas Velocity, ft/sec | 50.38 | 49.12 | 50.04 | 49.85 |
| Flue Gas Moisture, percent by volume | 8.71 | 8.61 | 9.01 | 8.78 |
| Average Flue Pressure, in. Hg | 29.47 | 29.47 | 28.96 | |
| Barometric Pressure, in. Hg | 29.50 | 29.50 | 29.25 | |
| Average %$CO_2$ by volume, dry basis | 14.0 | 13.7 | 13.6 | 13.8 |
| Average %$O_2$ by volume, dry basis | 4.3 | 4.3 | 4.4 | 4.3 |
| % Excess Air | 24.65 | 24.55 | 25.51 | 24.90 |
| Dry Molecular Wt. of Gas, lb/lb-mole | 30.411 | 30.368 | 30.352 | |
| Gas Sample Volume, dscf | 46.493 | 45.149 | 45.339 | |
| Isokinetic Variance | 98.8 | 98.9 | 98.6 | |

Laboratory Analysis can be found in Appendix F.

## Table 3-5
## STACK INDIVIDUAL RUN RESULTS

| Test Run Number: | 1 | 2 | 3 | Average |
|---|---|---|---|---|
| Source Condition | Normal | | | |
| Fuel Factor, dscf/$10^6$ Btu | 9648 | 9798 | 9647 | |
| Date | 9/1/99 | 9/1/99 | 9/2/99 | |
| Start Time | 10:35 | 14:50 | 8:15 | |
| End Time | 12:44 | 16:55 | 10:19 | |
| **Elemental Mercury:** | | | | |
| $HNO_3$-$H_2O_2$, ug detected | 0.682 | 0.612 | 0.508 | 0.601 |
| $H_2SO_4$-$KMnO_4$, ug detected | 7.563 | 2.083 | 2.863 | 4.170 |
| Reported, ug | 8.245 | 2.695 | 3.371 | 4.770 |
| ug/dscm | 3.20 | 1.59 | 2.10 | 2.30 |
| lb/hr | 0.00155 | 0.00078 | 0.00100 | 0.00111 |
| lb/$10^{12}$ Btu | 2.78 | 1.39 | 1.79 | 1.99 |
| **Oxidized Mercury:** | | | | |
| KCl, ug detected | 5.828 | 3.128 | 5.278 | 4.745 |
| Reported, ug | 5.828 | 3.128 | 5.278 | 4.745 |
| ug/dscm | 2.26 | 1.85 | 3.29 | 2.47 |
| lb/hr | 0.00110 | 0.00090 | 0.00156 | 0.00119 |
| lb/$10^{12}$ Btu | 1.96 | 1.62 | 2.80 | 2.13 |
| **Particle-bound Mercury:** | | | | |
| Filter, ug detected | 0.849 | 0.139 | 0.124 | 0.371 |
| $HNO_3$, ug detected | ND <0.004 | ND <0.004 | ND <0.004 | ND <0.004 |
| Reported, ug | 0.849 | 0.139 | 0.124 | 0.371 |
| ug/dscm | 0.33 | 0.08 | 0.08 | 0.16 |
| lb/hr | 0.00016 | 0.00004 | 0.00004 | 0.00008 |
| lb/$10^{12}$ Btu | 0.29 | 0.07 | 0.07 | 0.14 |
| **Total Outlet Speciated Mercury:** | | | | |
| ug/dscm | 5.79 | 3.52 | 5.48 | 4.93 |
| lb/hr | 0.00281 | 0.00172 | 0.00259 | 0.00238 |
| lb/$10^{12}$ Btu | 5.03 | 3.08 | 4.66 | 4.26 |
| Average Gas Volumetric Flow Rate: | | | | |
| @ Flue Conditions, acfm | 229,229 | 232,458 | 222,792 | 228,160 |
| @ Standard Conditions, dscfm | 129,757 | 130,572 | 126,300 | 128,876 |
| Average Gas Temperature, °F | 383.1 | 385.9 | 377.0 | 382.0 |
| Average Gas Velocity, ft/sec | 44.12 | 44.74 | 42.88 | 43.92 |
| Flue Gas Moisture, percent by volume | 8.05 | 8.46 | 7.95 | 8.16 |
| Average Flue Pressure, in. Hg | 29.41 | 29.41 | 29.21 | |
| Barometric Pressure, in. Hg | 29.45 | 29.45 | 29.25 | |
| Average %$CO_2$ by volume, dry basis | 12.2 | 12.0 | 12.2 | 12.1 |
| Average %$O_2$ by volume, dry basis | 6.4 | 6.3 | 6.1 | 6.3 |
| % Excess Air | 42.41 | 41.26 | 39.43 | 41.04 |
| Dry Molecular Wt. of Gas, lb/lb-mole | 30.208 | 30.172 | 30.196 | |
| Gas Sample Volume, dscf | 90.994 | 59.795 | 56.570 | |
| Isokinetic Variance | 97.9 | 101.0 | 98.8 | |

Laboratory Analysis can be found in Appendix F.

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## Table 3-6
## COAL USAGE RESULTS

| Test Run Number: | 1 | 2 | 3 | Average |
|---|---|---|---|---|
| Source Condition | Normal | | | |
| Date | 9/1/99 | 9/1/99 | 9/2/99 | |
| Start Time | 10:35 | 14:50 | 8:15 | |
| End Time | 12:43 | 17:13 | 10:31 | |
| **Coal Properties:** | | | | |
| Carbon, % dry | 76.84 | 75.41 | 76.98 | 76.41 |
| Hydrogen, % dry | 4.92 | 4.74 | 4.93 | 4.86 |
| Nitrogen, % dry | 1.66 | 1.71 | 1.68 | 1.68 |
| Sulfur, % dry | 0.85 | 0.77 | 0.85 | 0.82 |
| Ash, % dry | 9.16 | 8.31 | 8.44 | 8.64 |
| Oxygen, % dry (by difference) | 6.57 | 9.06 | 7.12 | 7.58 |
| Volatile, % dry | 35.65 | 36.10 | 35.60 | 35.78 |
| Moisture, % | 7.34 | 7.83 | 7.26 | 7.48 |
| Heat Content, Btu/lb dry basis | 13803 | 13181 | 13804 | 13596 |
| $F_d$ Factor $O_2$ basis, dscf/$10^6$ Btu | 9648 | 9798 | 9647 | 9698 |
| $F_c$ Factor $CO_2$ basis, scf/$10^6$ Btu | 1787 | 1836 | 1790 | 1805 |
| Chloride, ug/g dry | 1400 | 1400 | 1400 | 1400 |
| Mercury, ug/g dry | 0.07 | 0.05 | 0.06 | 0.06 |
| **Coal Consumption:** | | | | |
| A Feeder, RPM | 6.93 | 7.07 | 7.07 | |
| B Feeder, RPM | 6.88 | 7.02 | 6.90 | |
| C Feeder, RPM | 6.89 | 7.05 | 6.98 | |
| Total Raw Coal Input, lbs/hr | 37715 | 37835 | 37653 | 37734 |
| Total Coal Input, lbs/hr dry | 34947 | 34873 | 34919 | 34913 |
| **Total Mercury Available in Coal:** | | | | |
| Mercury, lbs/hr | 0.00245 | 0.00174 | 0.00210 | 0.00210 |
| Mercury, lbs/$10^{12}$ Btu | 5.07 | 3.79 | 4.35 | 4.40 |

Laboratory Analysis can be found in Appendix F.

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## 4.0 SAMPLING AND ANALYTICAL PROCEDURES

### 4.1 Test Methods

#### *4.1.1 Speciated mercury emissions*

Speciated mercury emissions were determined via the draft "Standard Test Method for Elemental, Particle-Bound, and Total Mercury in Flue Gas Generated from Coal-Fired Stationary Sources (Ontario-Hydro Method)", dated April 8, 1999. Any revisions to this test method issued after April 8, 1999, but before July 1, 1999, were incorporated.

The in-stack filtration (Method 17) configuration was utilized at the precipitator inlet and stack test locations. Figure 4-1 is schematic of the Ontario-Hydro sampling train.

Figure 4-2 illustrates the sample recovery procedure. The analytical scheme was per Section 13.3 of the Ontario-Hydro Method.


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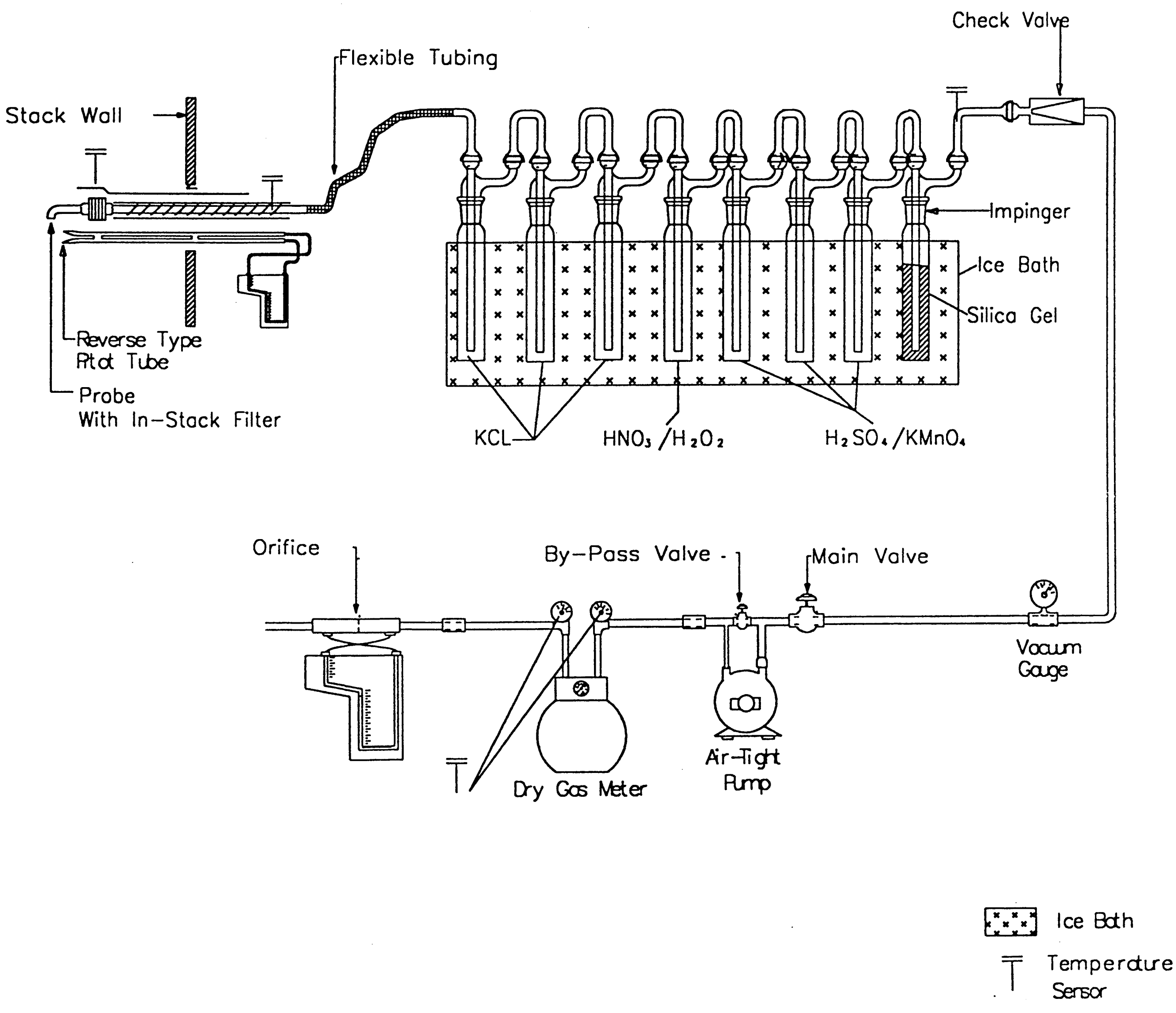
# Speciated Mercury Sampling Train Equipped with In-Stack Filter

## Ontario Hydro Method

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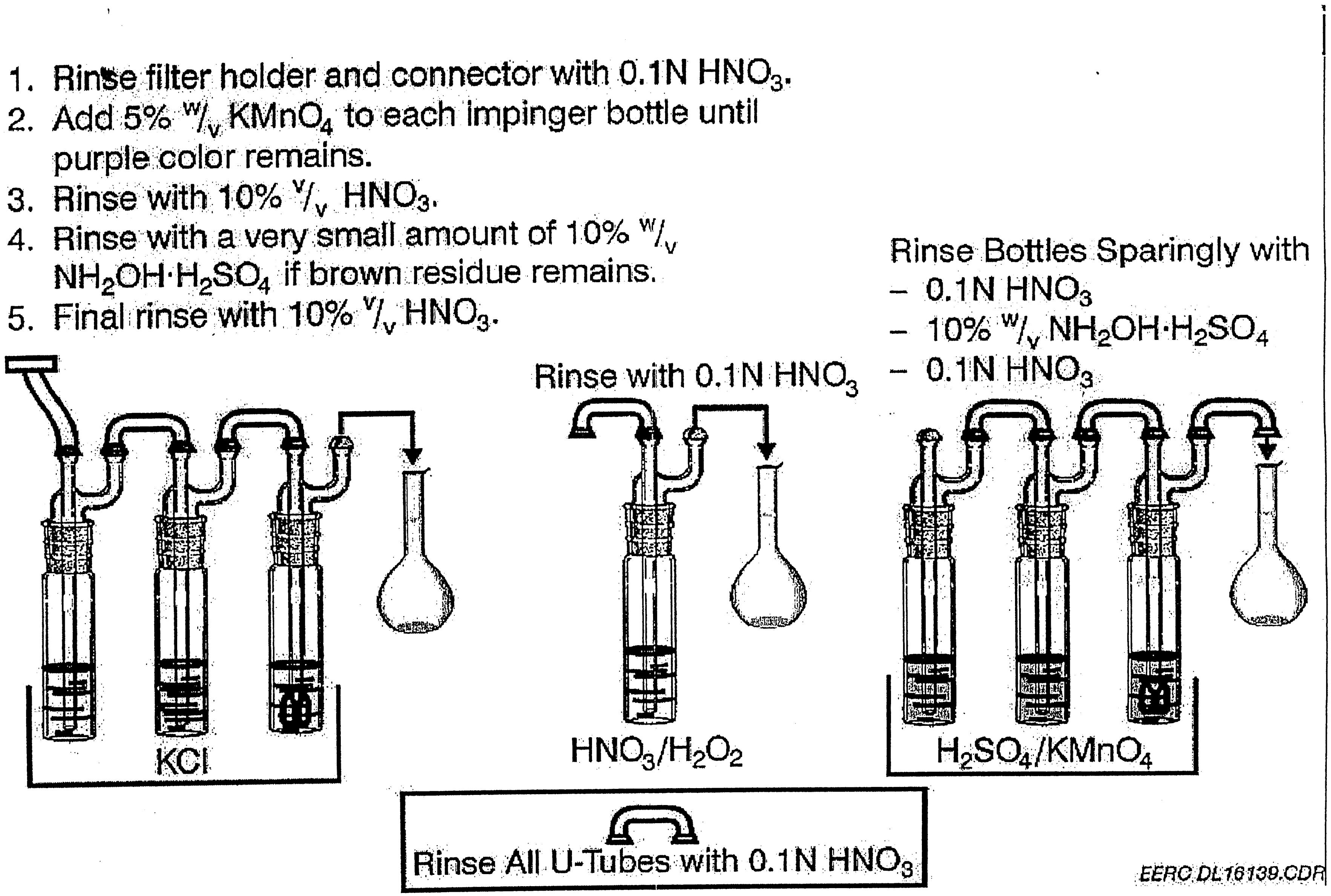


Figure 4-2: Sample Recovery Scheme for Ontario-Hydro Method Samples

### *4.1.2 Fuel Samples*

Fuel samples were collected by composite sampling. Three samples were collected at equally spaced intervals during each speciated mercury sampling run. Each set of three samples was composited into a single sample for each sample run. Sample analysis was conducted according to the procedures of ASTM D3684 and ASTM D4208.

### 4.2 Procedures for Obtaining Process Data

Plant personnel were responsible for obtaining process-operating data. The process data presented in Table 3-6 was continuously monitored by the facility. Process data was averaged over the course of each sample run.

### 4.3 Sample Identification and Custody

The chain-of-custody for all samples obtained for analysis can be found in Appendix E.

## 5.0 INTERNAL QA/QC ACTIVITIES

All sampling, recovery and analytical procedures conform to those described in the site specific test plan. All resultant data was reviewed by the laboratory and Mostardi Platt per the requirements listed in the QAPP and were determined to be valid except where noted below.

### 5.1 QA/QC Problems

Reagent blanks are required to be less than ten times the detection limit or ten percent of the sample values found. The reagent blanks, Sample IDs #037 and #038, for $KMNO_4/H_2SO_4$ were found to be 2.74 μg/L and 2.32 μg/L respectively which is more than ten times the detection limit of 0.06 μg/L. This value was also greater than ten percent of the results for the $KMNO_4/H_2SO_4$ impingers and therefore the data needs to be qualified.

Similarly, Sample ID #035 for KCl was found to be 3.04 μg/L which is more than ten times the detection limit. This value was also greater than ten percent of the results for the KCl impingers and therefore the data needs to be qualified.

The blank train values obtained at the inlet and outlet for $KMnO_4/H_2SO_4$ impinger Sample IDs #027 and #030 were higher than 30% of the values obtained for the $KMnO_4/H_2SO_4$ impingers.

We do not have an explanation for why these reagent blank and train blank values were so high for this project. The reagent blanks and train blanks have all been re-analyzed by the laboratory and all calculations checked. No information about what might have happened during testing is available. Other testing using similar reagents has not produced such dramatic results.

## 5.2 QA Audits

### *5.2.1 Reagent Blanks*

As required by the method, blanks were collected for all reagents utilized. The results of reagent blank analysis are presented in Table 5-1.

**Table 5-1**
**REAGENT BLANK ANALYSIS**

| Sample ID # | Sample Fraction | Contents | Mercury (μg) | Detection Limit (μg) |
|---|---|---|---|---|
| 034 | Front-half | 0.1N $HNO_3$/Filter | < 0.003 | 0.003 |
| 035 | 1 N KCl | 1 N KCl | 0.152 | 0.003 |
| 036 | $HNO_3/H_2O_2$ | $HNO_3/H_2O_2$ | < 0.010 | 0.010 |
| 037, 038 | $KMnO_4/H_2SO_4$ | $KMnO_4/H_2SO_4$ | 0.127 | 0.003 |

### *5.2.2 Blank Trains*

As required by the method, blank trains were collected at both the inlet and stack sampling locations. These trains were collected on September 1, 1999. The results of blank train analysis are presented in Table 5-2.

**Table 5-2**
**BLANK TRAIN ANALYSIS**

| Sample ID # | Sample Fraction | Contents | Mercury (μg) | Detection Limit (μg) |
|---|---|---|---|---|
| 031, 032, 033 | Front-half | Filter | 0.059 | 0.007 |
| 025 | KCl impingers | Impingers/rinse | 0.185 | 0.03 |
| 028 | KCl impingers | Impingers/rinse | 0.185 | 0.03 |
| 026 | $HNO_3$-$H_2O_2$ impingers | Impingers/rinse | < 0.004 | 0.004 |
| 029 | $HNO_3$-$H_2O_2$ impingers | Impingers/rinse | < 0.004 | 0.004 |
| 027 | $KMnO_4/H_2SO_4$ impingers | Impingers/rinse | 3.42 | 0.03 |
| 030 | $KMnO_4/H_2SO_4$ impingers | Impingers/rinse | 1.65 | 0.03 |


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### *5.2.3 Field Dry Test Meter Audit*

The field dry test meter audit described in Section 4.4.1 of Method 5 was completed prior to the test. The results of the audit are presented in Appendix C.


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